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ABSTRACT

It was hypothesized that the use of fading in response items of stimulus-response pairs constructed to simulate learning of a foreign language vocabulary would result in fewer errors than would the use of regular flash cards used in typical trial-and-error fashion. Subjects were college women volunteers randomly assigned to one of two experimental or control groups. One half of the subjects studied word pairs using a typical flash card technique; the other half used a modified flash card technique, designed to fade the response member. A 2x2x10 mixed analysis of variance was performed on the data. On the test trials, trial-and-error subjects showed better performance, i.e., fewer errors, than did fading subjects. The learning curves crossed so that control subjects appeared to be superior during test trials. The authors believe this was an artifact of the methodology used in the study and the scoring method. The study is being replicated with some procedural changes and a finer scoring method. The experimental subjects will be given feedback with the complete stimulus-response item on each learning trial. Partial correctness will be scored instead of an all-or-none score. (DWH)

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Errorless Differentiation Learning in a Paired-Associate Task

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INTRODUCTION

Trial-and-error learning has tended to dominate all other methods. In school, most children learn foreign languages, number tables, spelling, grammar, and other skills using flash cards. Recently, a stimulus fading technique has been used to produce errorless differentiation learning in a simulated college situation. Perhaps this technique could be modified for use in situations where flash cards have been used in the past.

In 1963, Terrace demonstrated errorless learning of stimulus discriminations in pigeons. He used a variety of procedures to fade in the negative stimulus so that, at first, it appeared in the bird's environment quite unobtrusively and then gradually became stronger as the discrimination training progressed. During this process, the pigeons learned to peck in the presence of the excitatory stimulus while they learned not to peck in the presence of the inhibitory stimulus. Terrace's study was followed by studies using other species. (See Rilling, 1977.) Later studies, such as those conducted by Moore and Goldiamond (1964) and Ellis, et al.,(1978), used an errorless fading procedure to demonstrate the effect of this technique on learning in young school-aged children. Further studies by Bricker, et al.,(1969) and by Touchette (1968) used the technique with retarded and institutionalized children.

Very little research has been published using normal human adult populations. Heckler, Fuqua, and Pennypacker (1975) studied the effect of errorless fading in the learning of complex verbal statements, testing college students.

In the Heckler study, all subjects were presented with complex statements taken from an almanac but altered in content so as to be

incorrect. For the control subjects, these statements were presente in a standard trial-and-error fashion using flash cards. At the botto of each flash card were the words "true - false" with the subjects required to guess the correct response, which had been assigned arbitrarily. For the experimental subjects, the words "true - false" provided a clue to the correct response. On the first trial, the correct response appeared in upper-case letters, the incorrect response in lower-case. On succeeding trials, the printing of the incorrect response was changed: lower-case letters were raised, one by one, to upper-case, so that on the final trial, all the letters were capitalized, for both the correct and the incorrect response. For control subjects, both "true" and "false" always appeared in upper-case letters.

The study showed that the experimental subjects were correct on about 70 to 75% of the items on the test trials, which is significantly superior to the control subjects who were correct on only 52 to 53% of the items, where guessing alone would produce 50% correct. Although the authors do not report changes in performance on a trial-by-trial basis, the technique was designed so that experimental subjects should have made no errors during this part of the procedure.

Since one of the commonest uses of flash cards is in the study of foreign language vocabulary, it seemed important to try to replicate the Heckler, et al. study in that context. We hypothesized that the use of fading in the response items of stimulus-response pairs, constructed to simulate the learning of a foreign language vocabulary, would result in fewer errors than would the use of regular flash cards used in the typical trial-and-error fashion.

METHOD

Design: A 2 x 2 x 10 mixed design was used. All subjects were presented with 10 randomly ordered paired-associates, with a different random order on each of the 10 trials. Five of the 10 pairs had an English stimulus member and a Nonsense response member; five were the reverse. One-half of the subjects studied the pairs using a typical flash card technique; the other half used a modified flash card technique, specifically designed to fade the response member.

Subjects: The subjects were 24 Lafayette College women volunteers from introductory courses in the Fall of 1981. Each subject was assigned randomly to one of four groups: two experimental and two control. (Please see Table 1.)

Apparatus and Materials: The flash card technique was simulated using 2 x 2 slides projected on a screen 3.20 meters in front of the subject (by means of a Kodac Carousel 750-H projector. Rate of presentation was controlled by a Hunter Digital Timer, Model 131-C. Instructions were presented by means of an Allied Cassette Recorder and Playback unit.)

All English words were selected from the A and AA categories in the Thorndike-Lorge Word Book(1944), and all were two syllable, 5-letter words, C V C V C. The Nonsense words were also C V C V C, constructed by combining syllables from Glaze's list (Stevens, 1951) of CVC trigrams, 47% and 53% association values. (See Table 2 for the complete sets of items used.)

Procedure: Subjects were run singly. They were seated at a table with the screen directly in front of them. After the taped instructions had been presented, the trials began. For the Control, or Trial-and-error subjects, the stimulus member was presented alone for 5 seconds,

followed by a blank 5-second interval, during which time the subject was instructed to try to write down the response item. The stimulus-response pair was then viewed for an additional 5 seconds. On Trials 2 - 10, this procedure was repeated, with subjects attempting to supply the response items.

For the Experimental, or Fading subjects, the first trial was conducted in exactly the same way as for the controls. However, throughout the rest of the trials, the Experimental subjects never again saw the complete stimulus-response pair. On Trials 2 and 3, the last letter of the response item was omitted. The subjects saw the stimulus and partial-response-item slide for 5 seconds, followed by a 5-second blank interval during which they were to write down the complete response item. On Trials 4 and 5, the last two letters of the response item were omitted, and so on until Trial 10, when all letters were omitted exactly as the Controls saw the item. (Please see Table 3.)

Trial 11 was a delayed recall test, identical with Trial 10. The delay period was introduced as a different part of the experiment and involved the participation in a complex electronic game (Comp-4 Model 4751-X2). The subjects were not aware that the delayed recall was forthcoming.

RESULTS

A 2 x 2 x 10 mixed ANOVA was performed on the data. (Please see Table 4.) The main effect for Fading versus Trial-and-error was significant. ($F = 9.74$; $df = 1,22$; $p < .01$) More errors were made overall by the Control subjects using the typical Trial-and-error technique than by the Experimental subjects using the Fading technique.

The main effect for type of response word was highly significant. ($F = 22.15$; $df = 1,22$; $p < .001$) More errors were made when the response item was a 5-letter Nonsense word than when it was a common 5-letter English word. Of interest to the possible application of these results in the real world, there was no interaction between the learning method and the type of response item: ($F = 0.24$) the Fading technique was no more or no less useful going from English to Nonsense than going from Nonsense to English.

The main effect for Trials was highly significant, ($F = 37.81$; $df = 9,198$; $p < .001$) with most of this effect due to the performance of the Control subjects; the F x T interaction was also highly significant showing a difference in rate of learning by the two groups. ($F = 23.48$; $df = 9, 198$; $p < .001$) (Please see Figure 1.) The curve of learning for the Control subjects is a typical negatively accelerated function; the curve for the Experimental subjects is not. In fact, this latter curve shows very little change throughout its length.

Simple effects were examined for the differences between Fading and Trial-and-error, on each of the 10 trials. (Please see Table 5.) Note that the Control subjects made significantly more errors on Trials 2 - 5; there were little or no differences between the methods on Trials 6 - 9. On both the Immediate Test (Trial 10) and the Delayed Test (Trial 11), the Experimental subjects made significantly

more errors. We will return to this in a moment, but please note tha the performance on Trials 10 and 11 for the Experimental subjects, although poorer than that for the Controls, is still very much superior to the performance of the Control subjects in the earlier trials. That is, Experimental subjects did indeed learn as they progressed through the trials. (The t-values are 8.43 and 8.80, respectively; df = 198; $p < .001$.) Please note again that the Control subjects saw the complete stimulus-response pairs on all learning trials; Experimental subjects saw the complete stimulus-response pairs on only the first trial; on all subsequent trials, the response members were progressively faded.

The interaction between type of response words and Trials was also highly significant. ($F = 7.95$; df = 9, 198; $p < .001$) Figure 2 shows this effect: the discrepancy between English words and Nonsense words was greater at the beginning of training than at the end. Table 6 shows that, trial by trial, there were more errors made when the response items were Nonsense words than when they were English words, and that the differences were significant on Trials 2 - 9, but not on the two Test Trials,(Trials 10 and 11).

The triple interaction was not significant. A comparison of Figures 3 and 4 shows that the interaction between learning method and trials was the same for both English response items and Nonsense response items.

DISCUSSION

Heckler, et al. reported better performance on test trials for subjects who studied true-false items under a fading technique, compared to subjects who used a typical trial-and-error technique. On our two test trials, the Trial-and-error subjects showed better performance, defined here as fewer errors, than did the Fading subjects. Overall, during the learning process, our Experimental subjects made fewer errors, and this may be important practically in terms of motivation, especially in a real situation with much larger "vocabularies" to be learned. Also it seems clear that the Experimental subjects did learn their vocabulary to a large extent: their performance on the test trials is significantly superior to the performance of the Control subjects on Trial 2. The question remains: why did the learning curves cross such that the Control subjects appear to be superior during the test trials? We believe this is an artifact of the methodology use in our study, and of the scoring method. We are now in the process of replicating our own study with some procedural changes and a finer scoring method, wherby the Experimental subjects are given feedback with the complete stimulus-response item on each learning trial, and wherby partial correctness will be scored instead of using an all-or-none score.

REFERENCES

Bricker, W.A., Heal, L.W., Bricker, D.D., Hayes, W.A. & Larsen, L. Discrimination learning and learning set with institutionalized retarded children. American Journal of Mental Deficiency, 1969, 74, 242-248.

Ellis, W.D., Ludlow, B.,& Walls, R.T. Learning, transfer and retention of errorless fading versus trial and error teaching. Psychological Reports, 1968, 43, 553-554.

Heckler, J.B., Fuqua, R.W., & Pennypacker, H.S. Errorless differentiation of academic responses by college students. Teaching of Psychology, 1975, 2, 103-107.

Moore, R. & Goldiamond, I. Errorless establishment of visual discriminations using fading procedures. Journal of the Experimental Analysis of Behavior, 1964, 7, 269-272.

Rilling, M. Stimulus control and inhibitory process. In Honig, W.K. & Staddon, J.E.R. (eds.) Handbook of Operant Behavior. Englewood Cliffs, N.J.: Prentice-Hall, 1977.

Stevens, S.S. Handbook of Experimental Psychology. John Wiley & Sons, Inc., 1951.

Terrace, H.S. Discrimination learning with and without "errors." Journal of the Experimental Analysis of Behavior, 1963, 6, 223-232.

Thorndike, E.L. & Lorge, J. The Teacher's Word Book of 30,000 Words. N.Y.: Columbia University Press, 1944.

Touchette, P.E. The effects of graduated stimulus change on the acquisition of the simple discrimination in severely retarded boys. Journal of the Experimental Analysis of Behavior, 1968, 11, 39-48.

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HANDOUT to accompany

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Table 1. Design of the Experiment.

Subjects	Materials	
Experimental (Fading)	Set A n=6	Set B n=6
Control (Trial-and-Error)	Set A n=6	Set B n=6

Table 2. Sets A and B, 10 pairs of English words and Nonsense items.

Set A	Set B
DUPOT - GIVEN	GIVEN - DUPOT
DAWEH - COVER	COVER - DAWEH
JAXUC - TOWER	TOWER - JAXUC
BIHUJ - SUGAR	SUGAR - BIHUJ
NOHAK - WAGON	WAGON - NOHAK
MINUS - DOJIX	DOJIX - MINUS
LABOR - HEFIG	HEFIG - LABOR
MUSIC - FEJOL	FEJOL - MUSIC
HUMAN - GIJAD	GIJAD - HUMAN
DEVIL - KUWEX	KUWEX - DEVIL

Table 3. Example of the Fading Technique used with the Experimental Subjects.

Trial	Stimulus	Response
1	CAMEL	JUBIC
2	CAMEL	JUBI-
3	CAMEL	JUBI-
4	CAMEL	JUB--
5	CAMEL	JUB--
6	CAMEL	JU---
7	CAMEL	JU---
8	CAMEL	J----
9	CAMEL	J----
10	CAMEL	-----

Table 4. Summary Table of the Analysis of Variance.

Source	Sum of Squares	DF	Mean Square	F	
F*	65.27	1	65.27	9.74	$p < .005$
Error	147.46	22	6.70		
W	56.72	1	56.72	22.15	$p < .001$
F x W	0.60	1	0.60	0.24	
Error	56.33	22	2.56		
T	252.04	9	28.00	37.81	$p < .001$
F x T	156.54	9	17.39	23.48	$p < 001$
Error	146.66	198	0.74		
W x T	31.01	9	3.45	7.95	$p < 001$
F x W x T	3.04	9	0.34	0.78	
Error	85.80	198	0.43		
Total	1001.48	479			

F* = Fading versus Nonfading.
W = Type of Response Word: English versus Nonsense.
T = Trials 2 - 11.

Table 5. Simple Effects for Learning Methods over Trials.

Trials	Mean Errors Trial-and-Error Ss.		Mean Errors Fading Ss.	F	
2	3.84	>	1.09	F = 44.20	p<.001
3	2.92	>	0.79	F = 21.18	p<.001
4	2.46	>	0.67	F = 13.28	p<.005
5	1.58	>	0.29	F = 14.08	p<.005
6	0.96	=	0.46	F = 2.76	ns
7	0.50	=	0.25	F = 1.00	ns
8	0.25	=	0.33	F = 0.27	ns
9	0.29	=	0.33	F = 0.17	ns
10	0.21	<	0.88	F = 4.59	p<.05
11	0.04	<	0.75	F = 8.30	p<.01

In all cases, df = 1,22.

Table 6. Simple Effects for Type of Response Word over Trials.

Trials	Mean Errors English Response		Mean Errors Nonsense Response	F	
2	1.71	<	3.21	F = 31.82	p<.001
3	1.13	<	2.58	F = 27.67	p<.001
4	0.96	<	2.17	F = 21.46	p<.001
5	0.54	<	1.33	F = 22.18	p<.001
6	0.38	<	1.04	F = 7.53	p<.025
7	0.17	<	0.59	F = 4.66	p<.05
8	0.12	<	0.46	F = 5.50	p<.05
9	0.08	<	0.54	F = 9.05	p<.025
10	0.46	=	0.63	F = 0.58	ns
11	0.38	=	0.42	F = 0.02	ns

In all cases, df = 1,22.

Figure 1. Mean Number of Errors by Method of Learning.

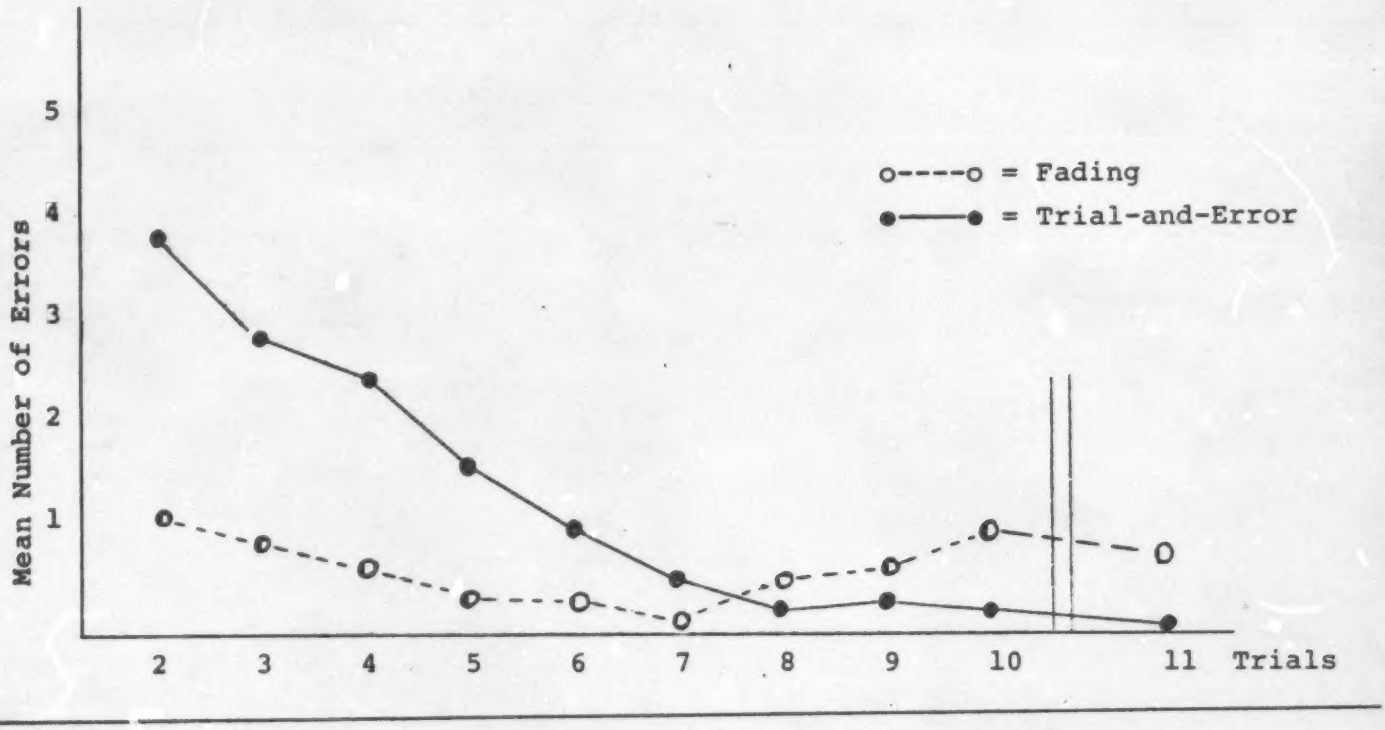

Figure 2. Mean Number of Errors by Type of Response Item.

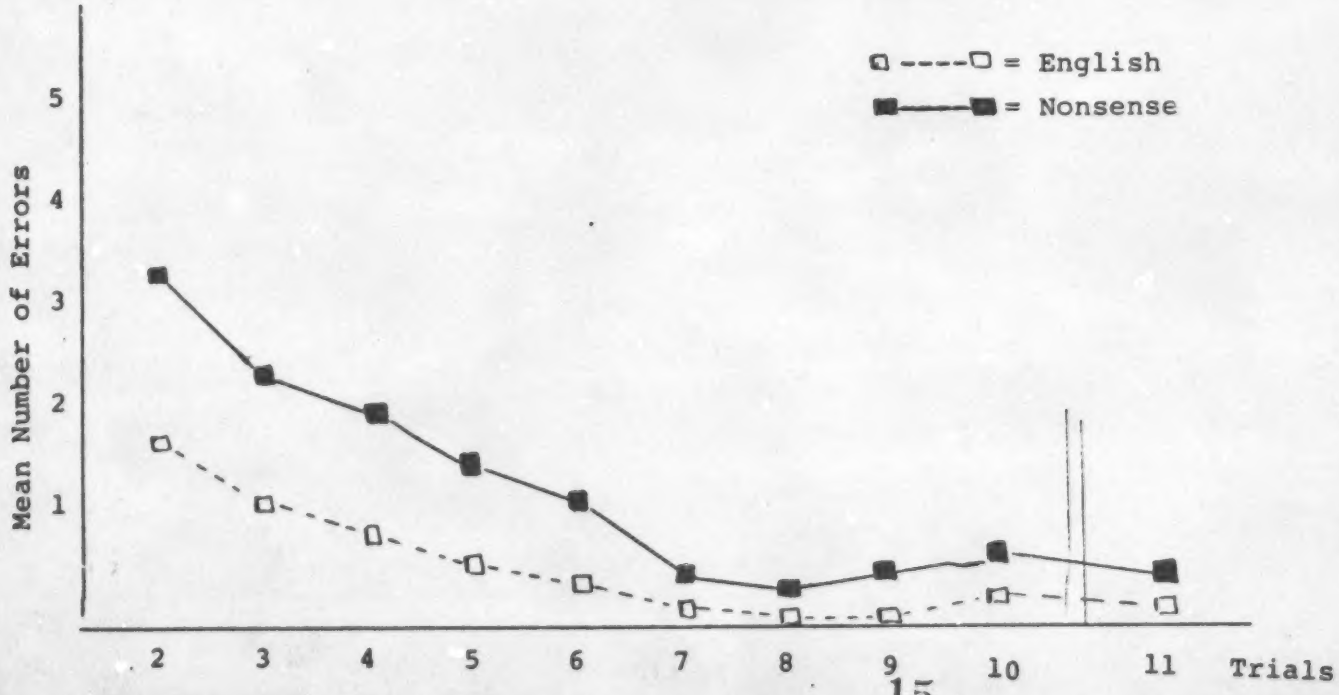

Figure 3. Mean Number of Errors for English Words by Learning Technique.

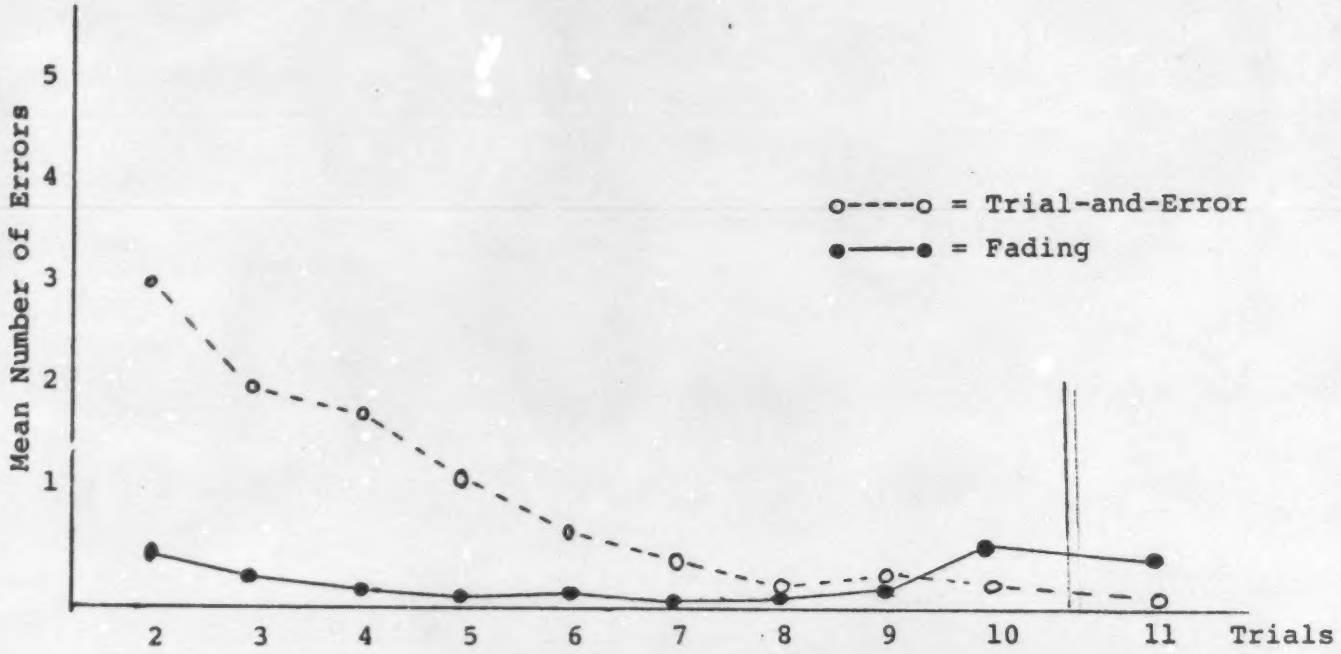

Figure 4. Mean Number of Errors for Nonsense Words by Learning Technique.